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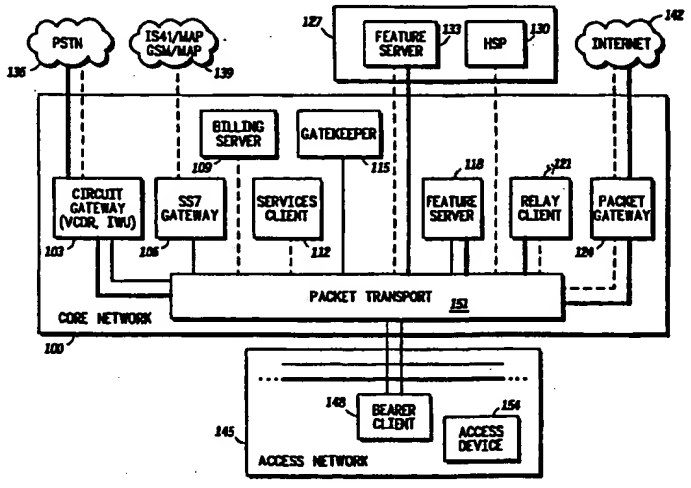
(54) Title: SESSION BASED BILLING IN A COMMUNICATION SYSTEM



(57) Abstract: Billing in a packet switched communication system is based on the quality of service (QoS) associated with each session a user may be involved in or establish, separate from the physical circuits they consume. In the preferred embodiment, a session may be, but is not limited to, a voice connection, an internet connection or a video conference connection. This QoS measure may be combined with total packets exchanged during a session to arrive at a connection detail record. If such a packet switched communication system is coupled to an access network (145), such as a wireless communication system, the use of a single radio channel in the wireless communication system may result in the generation of several detail records based on the number of distinct sessions in which a user engages.

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SESSION BASED BILLING IN A COMMUNICATION SYSTEM

RELATED APPLICATIONS

The following applications are related to this application and are filed on the date herewith. The disclosure of each of these related applications is incorporated by reference: S/N (Docket Number CE08072R) titled "METHOD FOR CHANGING COMMUNICATION IN A COMMUNICATION SYSTEM, AND COMMUNICATION SYSTEM THEREFOR"; S/N (Docket Number CE08136R) titled "METHOD FOR ESTABLISHING COMMUNICATION IN A PACKET NETWORK"; S/N (Docket Number CE08135R) titled "METHOD FOR RETRANSMITTING A DATA PACKET IN A PACKET NETWORK"; S/N (Docket Number CE08170R) titled "COMMUNICATION NETWORK METHOD AND APPARATUS"; S/N (Docket Number CE08169R titled "METHOD AND SYSTEM FOR PROCESSING INTELLIGENT NETWORK COMMANDS IN A COMMUNICATIONS NETWORK"; S/N (Docket Number CE08182R titled "METHOD AND SYSTEM FOR NETWORK SERVICE NEGOTIATION IN A TELECOMMUNICATIONS SYSTEM"; S/N (Docket Number CE08186R) titled "METHOD AND APPARATUS FOR ROUTING PACKET DATA IN A COMMUNICATIONS SYSTEM"; S/N (Docket Number CE08190R titled "METHOD AND SYSTEM FOR INTRODUCING NEW SERVICES INTO A NETWORK".

FIELD OF THE INVENTION

The present invention relates, in general, to communication systems and, more particularly, to billing of resource usage in such communication systems.

BACKGROUND OF THE INVENTION

In communication systems which employ the well-known circuit switched implementation, connection detail records typically contain information on who the caller is, what they dialed, where toll charges may be calculated and how long the circuit was held. Content carried over the circuit is irrelevant since the user is guaranteed the bandwidth of that entire circuit for the length of the connection. Post processing of the detail record leads to the actual customer bill itself, which is fundamentally duration and distance based.

With the implementation of packet switched communication networks and the influx of multimedia based applications, there is a need for a change in how billing is performed. With packet switching, multiple sessions can be accommodated over the same physical channel. Additionally, the consumption of resource associated with a particular channel will vary over the length of connection, expanding and contracting based on the nature of the application. In other words, it can no longer be assumed that the entire bandwidth of the circuit will be consumed throughout the connection. Additionally, distance based billing is also under question using the old billing model. Stated differently, the hierarchical toll network is no longer guaranteed and alternate means of measuring network resource consumption are required. To date, the Internet Service Providers (ISPs) have solved this problem by employing flat rate tariffing irrespective of resource consumption. This model will prove insufficient as traffic and utilization continue to grow.

Thus, a need exists for an improved method and apparatus which overcomes the deficiencies of prior implementations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 generally depicts a packet switched communication system capable of implementing session based billing in accordance with the invention.

FIG. 2 generally depicts a flow chart of how a notification of a charge is performed in accordance with the invention.

FIG. 3 generally depicts a flow chart of how a prepaid service data session is performed in accordance with the invention.

FIG. 4 generally depicts a flow chart of accounting for multiple sessions in accordance with the invention.

FIG. 5 generally depicts a flow chart illustrating distance based session billing in accordance with the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Stated generally, billing in packet switched communication systems is based on the quality of service (QoS) associated with each session a user may be involved in or establish, separate from the physical circuits they consume. In the preferred embodiment, a session may be, but is not limited to, a voice connection, an internet connection or a video conference connection. This QoS measure may be combined with total packets exchanged during a session to arrive at a connection detail record. If such a packet switched communication system is coupled to an access network, such as a wireless communication system, the use of a single radio channel in the wireless communication system may result in the generation of several detail records based on the number of distinct sessions in which a user engages.

A method of billing in a communication system comprising the steps of requesting a session by a user and determining quality of service requirements for each session the user of an access network establishes. The steps further include billing the user for each session based on the requested and received quality of service. In the preferred embodiment, the communication system includes an access network which further comprises one of either a wireless communication system, one or a plurality of cable modems, or a Digital Subscriber Line (DSL) access network. The wireless communication system further comprises one of either a trunked two-way system, a cellular communication system or a wireless data communication system.

Also in the preferred embodiment, the quality of service requirements further comprise a highest instantaneous bandwidth, latency (delay), frame erasure rate and vehicle speed at which service is provided. The vehicle speed at which service is provided is based on a direct correlation between resources required to maintain a

predetermined QoS within the access network and the vehicle speed itself. A session further comprises a voice connection, an internet connection or a video conference connection and the service request specifies a data session having parameters which include a desired QoS, termination address, user identity and facility requirements. Additionally, the QoS includes parameters related to the maximum bandwidth of the network, the average bandwidth of the network, the class of service, the maximum packet delay and the maximum packet loss rate and the facility requirements include the type of network to terminate the data session, header compression algorithms and data compression algorithms.

Stated in more detail, a method of performing session based billing in a communication system includes the steps of initiating a service request via an access device compatible with an access network, determining, in the access network, resource requirements associated with the service request and when a resource is available, forwarding the service request to a services client. The method further includes the steps of providing an identification, via a billing server, for associating billing data to the session in response to a query by the services client, notifying the access device of the identification and subscription data indicating the capability of the access device to support the requested service, registering the access device with the billing server and indicating features related to the service request to the billing server and building a virtual communication channel with the access device via the billing server. The method also includes the steps of establishing a connection between the access device and a terminating device and establishing an accounting set via the services client, receiving a session request at the terminating device and replying to the services client with an acceptance of the request and forwarding the acceptance of the request from the services client to the access device and establishing the resource within the access network to correspondingly establish a bearer path between the access device and the terminating device for the session.

The method further includes the step of associating, via the services client, the resource of the access network with the bearer path for that session. The subscription data indicates whether the access device supports a charge notification feature, prepayment capability or distance based billing. A session further comprises a voice connection, an internet connection or a video conference connection. The service request specifies a data session having parameters which include a desired QoS, termination address, user identity and facility requirements. The QoS includes

parameters related to the maximum bandwidth of the network, the average bandwidth of the network, the class of service, the maximum packet delay and the maximum packet loss rate and the facility requirements include the type of network to terminate the data session, header compression algorithms and data compression algorithms.

In still another method, distance based session billing in a communication system includes the steps of requesting, via an access device, that distance based billing be performed, establishing a session and associated accounting sets for the session, maintaining an average of a distance metric, mapping the distance metric to a tariffing structure and forwarding the distance metric to a billing server and implementing the distance based session billing in the billing server using the distance metric and quality of service (QoS) information.

The distance metric further comprises a number of hops a particular packet travels. Also, the distance metric further comprises a relative distance determined by monitoring responses to messages transferred by an egress gateway which issues periodic diagnostic messages which trace the route of packets, wherein the monitored responses include a list of elements traversed.

A communication system for implementing session based billing includes a bearer client for interpreting quality of service (QoS) parameters and for assigning resources for a desired QoS on a session basis, a billing server for correlating billing rates with services provided for a particular session and a services client for reporting information to the billing server 109 characterizing the static nature of the connection. The reported information includes an identity of the requesting party, the service(s) requested, a required QoS, connection duration and called party information. Each of the bearer client, a circuit gateway, a SS7 gateway and a packet gateway forward information to the billing server during a session to permit generation of charging information. The services client periodically polls network end points involved in the session.

FIG. 1 generally depicts a packet switched communication system capable of implementing session based billing in accordance with the invention. As shown in FIG. 1, a packet switched network such as core network 100 includes a packet transport 151 coupled to a circuit gateway 103, an SS7 gateway 106, billing server 109, services client 112, a gatekeeper 115, external (third-party) services 127, a feature server 118, a relay client 121 and a packet gateway 124. The circuit gateway 103 is coupled to the public switched telephone network (PSTN) 136 while the SS7

gateway 106 is coupled to an IS-41/MAP and GSM/MAP switching network 139. The packet gateway 124 is coupled to the internet 142. All of these elements are coupled to an access network 145 via the packet transport 151. In the preferred embodiment, the packet transport is well known and can be implemented using conventional packet switching techniques. Also in the preferred embodiment, the access network 145 can be a wireless communication system (such as a trunked two-way system, a cellular communication system or a wireless data communication system such as the Generalized Packet Radio System, better known as GPRS), one or a plurality of cable modems, Digital Subscriber Line (DSL) access networks, or any network which might readily be coupled to a packet switched network such as core network 100.

In the preferred embodiment, the circuit gateway 103 can be implemented using a Motorola Vangaurd 6560 voice over internet protocol (VoIP) telephony gateway, the SS7 gateway 106 can be an Ascend SS7 - signaling gateway, and the packet gateway 124 can be one of the Cisco 7500 family of IP routers, or equivalent with firewall security software and application software for service control.

The services client 112, feature server 118 and billing server 109 is software which is applied to a commercially available high availability (HA) computing platform running operating systems such as Unix, Linux or Windows NT. The HSP 130 is software which is applied to a commercially available high availability (HA) computing platform running operating systems such as Unix, Linux or Windows NT with database software and data storage array capability. The gatekeeper 115 is a gatekeeper available from NetSpeak.

The relay client 121 is software applied on circuit gateway 103 or packet gateway 124 as implemented by a collection of Cisco 7500 IP routers and Cisco 12000 Layer 3 switches interconnected by a variety of transmission media including ATM, SONET, Fiber, Gigabit Ethernet, or the like. The bearer client 148 is software applied to a Motorola Base Site Controller (BSC).

In the preferred embodiment, three elements are required to achieve session based billing in accordance with the invention. As one skilled in the art will appreciate, however, any number of elements which provide equivalent functionality may be employed in alternate embodiments. First, a control entity in the core network 100 is required, and in the embodiment shown in FIG. 1 this control entity is represented by the services client 112. Next, a multiplicity of accounting agents are

required in the access network 145 and core network, and in the embodiment shown in FIG. 1 these accounting agents are represented by the bearer client 148 and the gateway (packet 124 or circuit 103). Finally, an accounting aggregation point is required, which in the embodiment shown in FIG. 1 is represented by the billing server 109. These three elements combined produce detail records for each unique session in which a user is involved, independent of the resource utilized.

The role of the services client 112 is to report information to the billing server 109 characterizing the static nature of the connection. Such information might include an identity of the requesting party, the service(s) requested, a required QoS, connection duration, called party information, etc. It also plays a role in immediate billing situations, to be discussed.

The role of the bearer client 148 in the access network 145 is to interpret the necessary QoS parameters and to assign resources for a desired QoS on a per stream or session basis within a bearer channel. Information is collected at the access network 145 and is passed on to the billing server 109 via packet transport 151. Other data gateway elements such as a Packet Data Serving Node (PDSN), which is not shown for clarity but would be coupled to packet gateway 124, may be involved in collecting such information from the access network 145, adding their own details and passing them on to an accounting server. It is possible that the end user may not be provided the same QoS over the access network 145 and the core network 100 simultaneously and as such, correlation and assessment of overall QoS provided can only be performed at a common point where they have the information from the access network 145 as well as the core network 100. An example of such coordination might be that a user is billed at a higher rate only if the user received the bandwidth and throughput at both the access network 145 and the core network 100. This correlation is a function of the billing server 109. QoS parameters include, but are not limited to, highest instantaneous bandwidth, latency (delay), frame erasure rate, vehicle speed at which service was provided, etc. The notion of incorporating vehicle speed during the session into the detail record is based on the premise that there is a direct correlation between resources required to maintain a predetermined QoS within the access network 145 and the vehicle speed itself.

Since there may be a real time nature to billing (i.e., payphones, pre-paid, meter pulses, etc.), the bearer client 148 and the circuit gateway 103, SS7 gateway 106 and the packet gateway 124 must forward information to the billing server 109

during a connection to permit generation of charging information. This is done under the coordination of the services client 112, which will periodically poll the network end points involved in the connection to forward their current QoS information as described below. This information is then correlated at the billing server 109 and the services client 112 may then drive the appropriate notification sequence to the end user.

FIG. 2 generally depicts a flow chart of how a notification of a charge is performed in accordance with the invention. First, at step 200, an access device 154 of the access network 145 initiates a service request. In the preferred embodiment, the access device 154 can be a cellular telephone, a two-way radio, a modem, a set-top box or any other device compatible with the particular access network 145. The access device 154 generates a system access request with the service request embedded.

The access network 145 next evaluates, at step 203, the embedded service request to determine the fundamental resource requirements. In this example, the service request specifies a data session with the following parameters: desired QoS, termination address, subscriber identity, and facility requirements. QoS defines a variable number of parameters related to the performance of the communications resource which include, but are not limited to: maximum bandwidth, average bandwidth, class of service (e.g. best effort, guaranteed delivery, expedited delivery, send first, etc.), maximum packet delay, and maximum packet loss rate. Facility requirements include: type of network to terminate data session (i.e., Internet, intranet, etc.), header compression algorithms and data compression algorithms.

Next, a test is performed at step 206 by the access network 145 to determine if resources are available. If they are, the service request is forwarded to the services client 112 at step 209; otherwise, standard handling is applied to treat insufficient resources to the satisfy request condition at step 212 as is known in the art. After step 212, the services client 112 begins processing of service request at step 215. This is done by determining if the requested service is available to the user. If so, the service request is accepted and a response is issued to the user via the access network 145. Otherwise, the treatment for invalid service request is applied as is known in the art.

The services client 112 then queries the billing server 109 for an aggregation identification (ID) for purposes of subsequent association and amalgamation of the billing data at step 218. The billing server 109 allocates the ID and returns that information to the services client 112. The services client 112 then commences accounting for this session.

Subscription data is obtained from a Home Location Register (HLR, not shown) or equivalent element and is stored at the services client 112 when the services client 112 is instantiated. The subscription data indicates that the access device 154 has the charge notification feature. The services client 112 instructs the access device 154 of the aggregation ID at step 221. The access device 154 registers with the billing server 109 (using the aggregation ID) and indicates this session is an on-line billed call, where the billing server 109 forwards accounting data to the access device 154 as received. The billing server 109 receives the registration and builds a virtual communications channel with the access device 154 in response.

The services client 112 then initiates a session establishment dialogue to a terminating device (via a terminating address) at step 224. The dialogue can be sent to another services client, a circuit gateway 103 or packet gateway 124 depending on the terminating address. The services client 112 also sets up the accounting set for the requested service. In this embodiment, the aggregation ID must be forwarded to a gateway point serving the terminating address, where it will subsequently be used for forwarding billing information. The gateway point is generically used to represent a circuit gateway 103 or a packet gateway 124 depending on which is appropriate for the terminating address. The terminating gateway point then instantiates the accounting agent in the gateway 103 or 124.

The terminating element (client or gateway) will next establish an accounting set at step 227 based on the logic contained within that element. The terminating element informs the terminating device of the session request. The terminating device replies to the request with an accept response which is propagated to the services client 112.

The services client 112 receives the session accept at step 230 and forwards the session accept to the requesting access device 154. The accounting agent associated with the access network 145, such as a bearer client 148, is then instantiated as well. A resource of the access network 145 can be established at this

point or may occur for optimization. The services client 112 associates the resource of the access network 145 with the bearer path for the session.

In this embodiment, the bearer client 148 measures the peak throughput, the average throughput, packet loss and the duration of the session. The bearer client 148 issues a periodic sample of the data to the billing server 109. Based on the previous registration, the billing server 109 forwards this information to the access device 154 for immediate display.

The requesting access device 154 disconnects at step 233 upon completion of the session. This disconnect is forwarded to the services client 112 which manages the release of the session resources to the terminating address.

As the session is released, the bearer client 148 will issue end-of-session notification at step 236 to the billing server 109, indicating the cessation of that session cycle. This end-of-session notification is then forwarded from the billing server 109 to the access device 154. The billing server 109 then ends the service and idles the aggregation ID for future use. The access network 145 releases it resources at step 239 based on the disconnect indicator from the access device 154.

FIG. 3 generally depicts a flow chart of how a prepaid service data session is performed in accordance with the invention. At step 300, a user initiates a service request via the access device 154. The access device 154 generates a system access request with the service request embedded therein. The access network 145 evaluates, at step 303, the embedded service request to determine the fundamental resource requirements. In this embodiment, the service request specifies a data session with the following parameters: desired QoS, termination address, user identity, and facility requirements. QoS defines a variable number of parameters related to the performance of the communications resource, which include: maximum bandwidth, average bandwidth, class of service (e.g., best effort, guaranteed delivery, expedited delivery, send first, etc.), maximum packet delay and maximum packet loss rate. The facility requirements include: the type of network to terminate the data session (i.e., Internet, intranet, etc.), header compression algorithms and data compression algorithms.

Next, a test is performed at step 306 by the access network 145 to determine if resources are available. If they are, the service request is forwarded to the services client 112 at step 309; otherwise, standard handling is applied to treat insufficient resources to the satisfy request condition at step 312 as is known in the art.

The services client begins processing of the service request at step 315 by first determining if the requested service is available to the access device 154. If so, the service request is accepted and a response is issued to the access device 154 via the access network 145. Otherwise, the treatment for invalid service request is applied as is known in the art. The services client 112 then queries the billing server 109 at step 318 for an aggregation ID for purposes of subsequent association and amalgamation of the billing data. The billing server 109 allocates the ID and returns that information to the services client 112, which commences accounting for the session.

Again, subscription data is obtained from a Home Location Register (HLR, not shown) or equivalent element and is stored at the services client 112 when the services client 112 is instantiated. The subscription data indicates at step 321 that the access device 154 has prepayment capability for this service. The services client 112 initiates a dialogue at step 324 to the feature server 118 providing prepaid service control for the access device 154 as identified in the subscription data, passing along the aggregation ID for purposes of interacting with the billing server 109. The feature server 118 establishes the current credit available to the user of the access device 154 and accounting. The feature server 118 checks to ensure that sufficient credit exists to establish the session. The services client 112 is informed of these details of the service accounting set from the feature server 118 and the feature server 118 then registers with the billing server 109 (using the aggregation ID) and indicates this is a on-line billed call, where the billing server 109 forwards accounting data to the feature server 118 as received. The billing server 109 receives the registration and builds a virtual communications channel with the feature server 118 in response.

The services client 112 then initiates a session establishment dialogue to a terminating device (via a terminating address) at step 327. The dialogue can be sent to another services client, a circuit gateway 103 or a packet gateway 124 depending on the terminating address. The service client 112 also sets up the accounting set for the requested service. The aggregation ID is forwarded to the gateway point serving the terminating address, where it will subsequently be used for forwarding billing information. The terminating gateway point must then instantiate the accounting agent in the gateway 103 or 124.

The terminating element (client or gateway) then establishes an accounting set at step 330 based on the logic contained within that element. The terminating

element informs the terminating address of the session request and the terminating device replies to the request with an accept response, which is forwarded to the services client 112.

The services client 112 receives the session accept at step 333 and forwards the session accept to the requesting access device 154. The accounting agent associated with the access network 145, such as a bearer client 148, is then instantiated as well. A resource of the access network 145 can be established at this point or may occur at a later point for the purpose of resource optimization. The services client 112 associates the resource of the access network 145 with the bearer path for the session.

In this embodiment, the bearer client 148 measures the peak throughput, the average throughput, packet loss and the duration of the session. The bearer client 148 issues a periodic sample of the data to the billing server 109. Based on the previous registration, the billing server 109 forwards this information to the access device 154 for immediate display. The length of the period is determined by subscription data and as an example, can be 15 seconds.

The feature server 118 receives the current sample and executes the associated costing algorithm at step 336. In this case, two costs are generated: one for duration and one for average throughput. In the preferred embodiment, the algorithm selects the greater amount for the first 15 minutes and the lessor amount thereafter and the user's credit is adjusted accordingly. The feature server 118 determines at step 339 when the session is at risk of disconnect due to lack of credit and provides the services client 112 with an indication at step 342 if there is such a risk.

Upon completion of the session, the access device 154 disconnects at step 345. This is forwarded to the services client 112 which manages the release of the session resources to the terminating address and also forwards the current account record to the feature server 118 for final cost. The feature server 118 recognizes the service has terminated.

As the session is released, the accounting agents (including bearer client 148) will issue end-of-session notifications to the billing server 109 at step 348, indicating the cessation of that session cycle. This information is then forwarded from the billing server 109 to the feature server 118. The billing server 109 then ends the service and idles the aggregation ID for future use. The access network 145 then

releases the resources at step 351 based on the disconnect indicator from the access device 154.

FIG. 4 generally depicts a flow chart of accounting for multiple sessions in accordance with the invention. At step 400, the user initiates a service request via access device 154 by generating a system access request with the service request embedded therein. Next, at step 403, a session is established as described with reference to, for example, FIG. 2 or FIG. 3. The accounting sets are in place at the appropriate points.

At step 406, a subsequent service request is initiated by the user via access device 154. Evaluation of the requests determines that the requirements to support the service are met by the existing assignments. The services client 112 then queries the billing server 109 at step 409 for an aggregation ID associated to the new service. The billing server 109 allocates the ID and returns that information to the services client 112 which then commences accounting for the newly requested session.

The services client 112 then initiates a session establishment dialogue to the terminating address at step 412. The dialogue can be sent to another services client, a circuit gateway 103 or packet gateway 124 depending on the terminating address. The services client 112 also sets up the accounting set for the requested service. Again, in this embodiment, the aggregation ID must be forwarded to the gateway point serving the terminating address, where it will subsequently be used for forwarding billing information. The terminating gateway point must then instantiates the accounting agent. It is noted that the terminating gateway for the new service may or may not be the same gateway used for the initial session, depending on the destination address for the newly requested session.

At step 415, the terminating element (client or gateway) establishes an accounting set based on the logic contained within that element and then informs the terminating device having the terminating address of the session request. The terminating device replies to the request with an accept response which is then propagated to the services client 112.

At step 418, the services client 112 receives the session accept and it is propagated to the requesting subscriber. The accounting agent associated with the access network, such as bearer client 148, is then instantiated as well. The services client 112 associates the access network resources with the bearer path for the session and then issues an accounting event to the billing server 109 indicating that a

multiple service session has been established, that no setup was required and the type of service requested. The bearer client 148 generates measurements as specified.

At step 421, a test is performed to determine whether the user, via the access device 154, initiates another service request. If not, the current session is maintained at step 424. If another session is requested, services client 112 analyzes the request and the current resource assignments at step 427. The services client 112 then negotiates with the access network 145 to request suitable resources and with the core network 100 obtain suitable resources. If either the access network 145 or the core network 100 cannot meet the request, the service request receives "service specific exception handling". An example of "service specific exception handling" might be a reject or negotiation for a reduced set of resources for a lower service QoS. After step 430, the flow is identical to steps 318-333 as shown in FIG. 3 and is represented by step 433.

Upon completion of the session, the access device 154 requests that the session be disconnected at step 436. This request is forwarded to the services client 112 which manages the release of the session resources to the terminating address. As the session is disconnected, the accounting agents will issue an end-of-session notification to the billing server 109, indicating the cessation of that call session. This information is then forwarded from the billing server 109 to the feature server 118. The billing server 109 then ends the service and idles the aggregation ID for future use. However, in this case the initial aggregation ID remains in service. The access network 145 releases it resources based on the disconnect indicator from the access device 154. The remaining elements involved in the still active sessions continue to perform accounting as directed.

When the user, via the access device 154, disconnects from another session at step 439, the services client 112 determines that resource requirements have decreased and negotiates to reduce the resources involved for the access device 154. The services client 112 manages the release of the session resources to the terminating address and issues an accounting event to the billing server 109 indicating resource usage decrease, termination of multiple service session as well as the type of service terminated. As the session is released, the accounting agents will issue an end-of-session notification to the billing server 109, indicating the cessation of that call session. This information is then forwarded from the billing server 109 to the feature server 118. The billing server 109 ends the service and idles the

aggregation ID for future use. The access network 145 releases it resources based on the disconnect indicator from the access device 154. Release of any other sessions still in progress is handled in a like manner.

FIG. 5 generally depicts a flow chart illustrating distance based session billing in accordance with the invention. At setup, the originating party requests that the field counting nodes that have been traversed, such as the IP filed TTL (Time To Live) or a newly defined field, be set to some value which can be related to QoS with respect to relative delay based on some distance metric at step 500. One example of a distance metric is a number of hops traveled by a packet, where a hop represents the transfer of a packet from one node to another. The terminating party indicates the TTL to the originator in the reply. The steps described above to establish the session and accounting mechanisms are implemented in this embodiment, and are represented by step 503.

Once the bearer path is established and active, a processor within the access network 145 calculates the number of hops for the packet and builds a running average at step 506. This value is reported to the billing server 109 via the periodic accounting reports from the account agent which receives the packets. The distance metric is mapped to a differential tariff structure, embedded within the accounting set and forwarded to the billing server 109. At this point, distance based session billing is implemented at step 512 using the distance metric and the session based billing techniques described above in accordance with the invention.

A poor configuration of routing tables can lead to more hops than necessary, which in turn will result in an increased delay. As such, the number of hops for the packet does not necessarily correlate to distance. To overcome this, a method to determine the relative distance is employed. This can be performed by the using gateway implemented. The egress gateway issues periodic diagnostic messages that trace the route in which a particular packet takes. The response message includes a list of elements traversed. This information can be post processed to validate the distance metric obtained during the session.

As described, the billing is separated from the physical resource involved (i.e., the circuit) in accordance with the invention. Instead, the billing is based on service desired and packets exchanged at a negotiated QoS.

While the invention has been particularly shown and described with reference to a particular embodiment, it will be understood by those skilled in the art that

various changes in form and details may be made therein without departing from the spirit and scope of the invention. The corresponding structures, materials, acts and equivalents of all means or step plus function elements in the claims below are intended to include any structure, material, or acts for performing the functions in combination with other claimed elements as specifically claimed.

What we claim is:

CLAIMS

1. A method of billing in a communication system comprising the steps of:

requesting a session by a user;

determining quality of service requirements for each session the user of an access network establishes; and

billing the user for each session based on the requested and received quality of service.

2. The method of claim 1, wherein the communication system includes an access network which further comprises one of either a wireless communication system, one or a plurality of cable modems, or a Digital Subscriber Line (DSL) access network.

3. The method of claim 2, wherein the wireless communication system further comprises one of either a trunked two-way system, a cellular communication system or a wireless data communication system.

4. The method of claim 1, wherein the quality of service requirements further comprise a highest instantaneous bandwidth, latency (delay), frame erasure rate and vehicle speed at which service is provided.

5. The method of claim 4, wherein the vehicle speed at which service is provided is based on a direct correlation between resources required to maintain a predetermined QoS within the access network and the vehicle speed itself.

6. The method of claim 1, wherein a session further comprises a voice connection, an internet connection or a video conference connection.

7. The method of claim 1, wherein the service request specifies a data session having parameters which include a desired QoS, termination address, user identity and facility requirements.

8. The method of claim 7, wherein the QoS includes parameters related to the maximum bandwidth of the network, the average bandwidth of the network, the class of service, the maximum packet delay and the maximum packet loss rate.

9. The method of claim 7, wherein the facility requirements include the type of network to terminate the data session, header compression algorithms and data compression algorithms.

10. A method of performing session based billing in a communication system, the method comprising the steps of:

initiating a service request via an access device compatible with an access network;

determining, in the access network, resource requirements associated with the service request;

when a resource is available, forwarding the service request to a services client;

providing an identification, via a billing server, for associating billing data to the session in response to a query by the services client;

notifying the access device of the identification and subscription data indicating the capability of the access device to support the requested service;

registering the access device with the billing server and indicating features related to the service request to the billing server;

building a virtual communication channel with the access device via the billing server;

establishing a connection between the access device and a terminating device and establishing an accounting set via the services client;

receiving a session request at the terminating device and replying to the services client with an acceptance of the request; and

forwarding the acceptance of the request from the services client to the access device and establishing the resource within the access network to correspondingly establish a bearer path between the access device and the terminating device for the session.

11. The method of claim 10, further comprising the step of associating, via the services client, the resource of the access network with the bearer path for that session.

12. The method of claim 10, wherein the subscription data indicates whether the access device supports a charge notification feature, prepayment capability or distance based billing.

13. The method of claim 10, wherein a session further comprises a voice connection, an internet connection or a video conference connection.

14. The method of claim 10, wherein the service request specifies a data session having parameters which include a desired QoS, termination address, user identity and facility requirements.

15. The method of claim 14, wherein the QoS includes parameters related to the maximum bandwidth of the network, the average bandwidth of the network, the class of service, the maximum packet delay and the maximum packet loss rate.

16. The method of claim 14, wherein the facility requirements include the type of network to terminate the data session, header compression algorithms and data compression algorithms.

17. A method of distance based session billing in a communication system comprising the steps of:

requesting, via an access device, that distance based billing be performed;

establishing a session and associated accounting sets for the session;

maintaining an average of a distance metric;

mapping the distance metric to a tariffing structure and forwarding the distance metric to a billing server; and

implementing the distance based session billing in the billing server using the distance metric and quality of service (QoS) information.

18. The method of claim 17, wherein the distance metric further comprises a number of hops a particular packet travels.

19. The method of claim 18, wherein the distance metric further comprises a relative distance determined by monitoring responses to messages transferred by an egress gateway which issues periodic diagnostic messages which trace the route of packets, wherein the monitored responses include a list of elements traversed.

20. A communication system for implementing session based billing, the communication system comprising:

a bearer client for interpreting quality of service (QoS) parameters and for assigning resources for a desired QoS on a session basis;

a billing server for correlating billing rates with services provided for a particular session; and

a services client for reporting information to the billing server 109 characterizing the static nature of the connection.

21. The communication system of claim 20 wherein the reported information includes an identity of the requesting party, the service(s) requested, a required QoS, connection duration and called party information.

22. The communication system of claim 20, wherein the bearer client, a circuit gateway, a SS7 gateway and a packet gateway forward information to the billing server during a session to permit generation of charging information.

23. The communication system of claim 22 wherein the services client periodically polls network end points involved in the session.

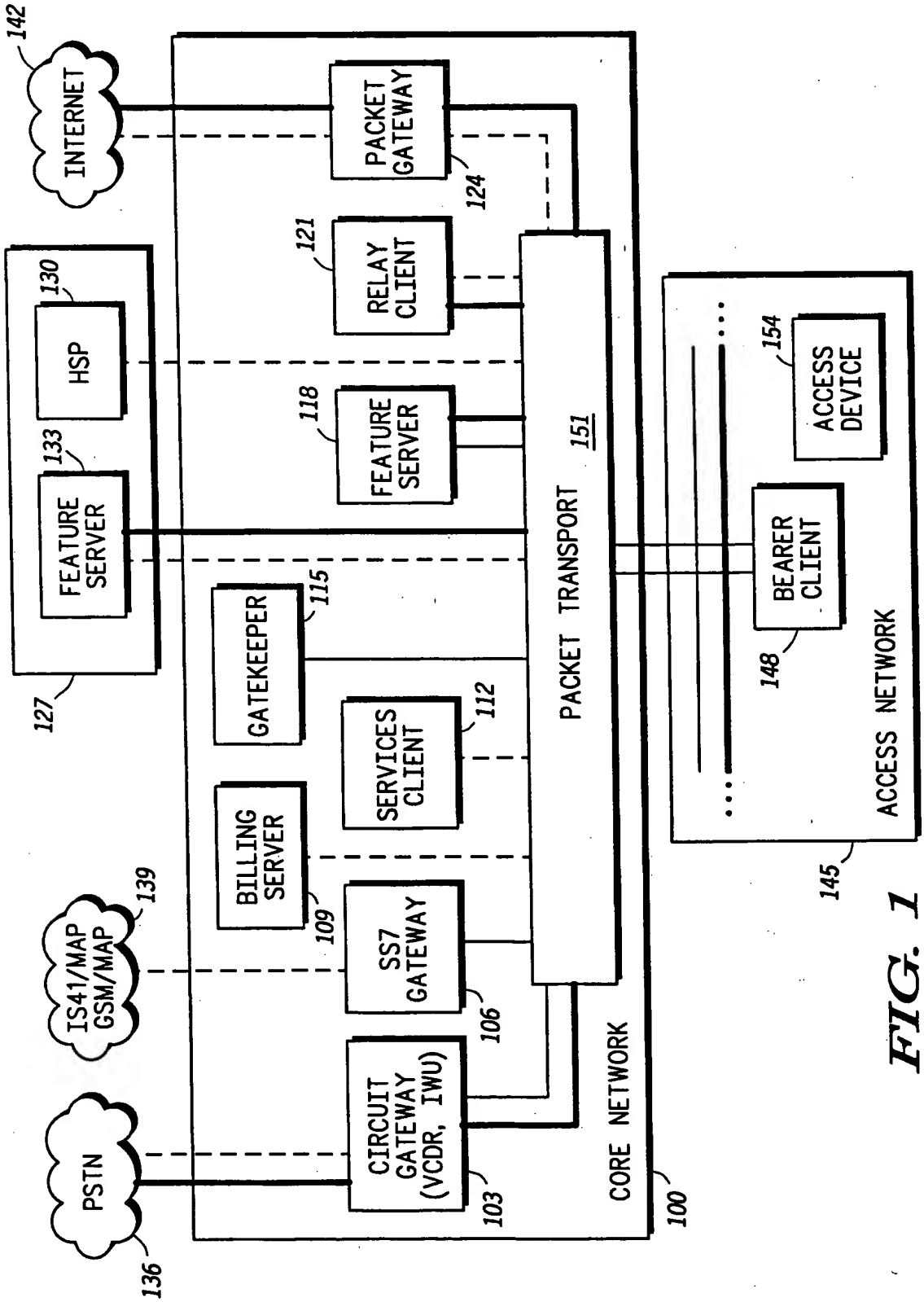
142
INTERNET
PACKET GATEWAY
124
121
RELAY CLIENT
130
HSP
118
FEATURE SERVER
133
FEATURE SERVER
127
PACKET TRANSPORT
151
154
ACCESS DEVICE
BEARER CLIENT
148
GATEKEEPER
115
SERVICES CLIENT
112
ACCESS NETWORK
145
BILLING SERVER
109
SS7 GATEWAY
106
139
IS41/MAP GSM/MAP
CIRCUIT GATEWAY (VCDR, IWU)
103
PSTN
136
CORE NETWORK
100

FIG. 1

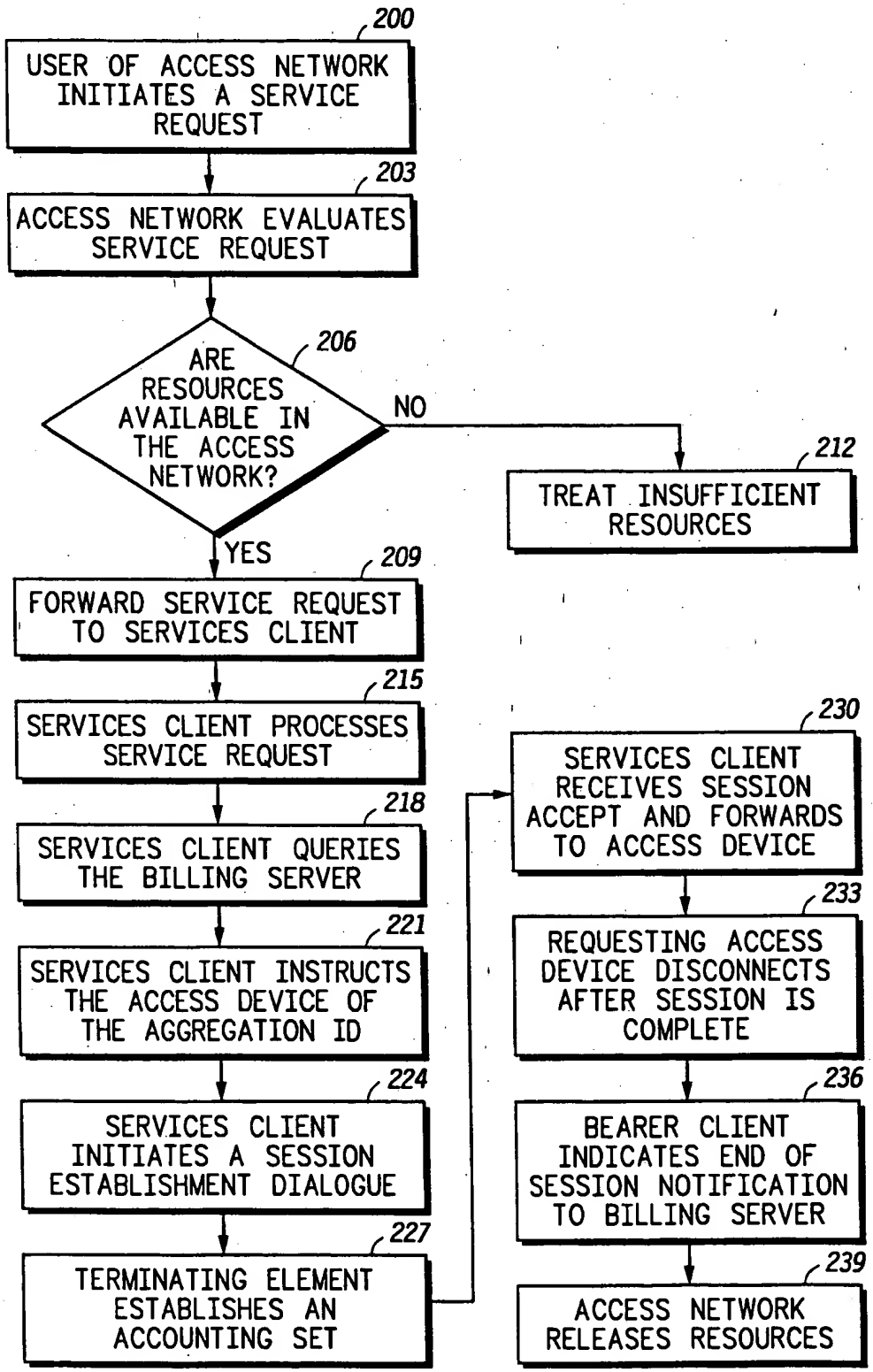
200
USER OF ACCESS NETWORK INITIATES A SERVICE REQUEST
203
ACCESS NETWORK EVALUATES SERVICE REQUEST
206
ARE RESOURCES AVAILABLE IN THE ACCESS NETWORK?
NO
212
TREAT INSUFFICIENT RESOURCES
YES
209
FORWARD SERVICE REQUEST TO SERVICES CLIENT
215
SERVICES CLIENT PROCESSES SERVICE REQUEST
218
SERVICES CLIENT QUERIES THE BILLING SERVER
221
SERVICES CLIENT INSTRUCTS THE ACCESS DEVICE OF THE AGGREGATION ID
224
SERVICES CLIENT INITIATES A SESSION ESTABLISHMENT DIALOGUE
227
TERMINATING ELEMENT ESTABLISHES AN ACCOUNTING SET
230
SERVICES CLIENT RECEIVES SESSION ACCEPT AND FORWARDS TO ACCESS DEVICE
233
REQUESTING ACCESS DEVICE DISCONNECTS AFTER SESSION IS COMPLETE
236
BEARER CLIENT INDICATES END OF SESSION NOTIFICATION TO BILLING SERVER
239
ACCESS NETWORK RELEASES RESOURCES

FIG.2

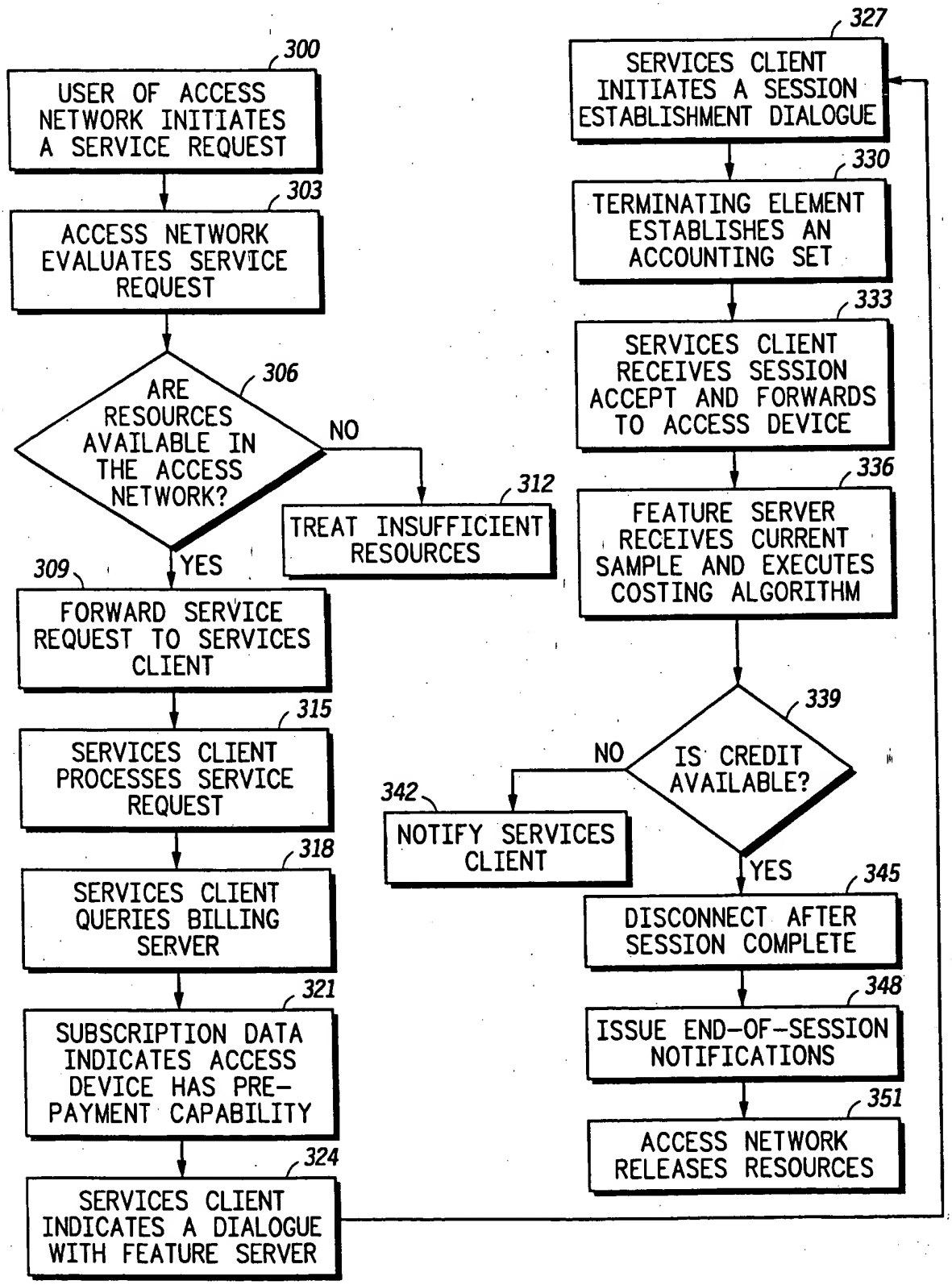
300
USER OF ACCESS NETWORK INITIATES A SERVICE REQUEST
303
ACCESS NETWORK EVALUATES SERVICE REQUEST
306
ARE RESOURCES AVAILABLE IN THE ACCESS NETWORK?
NO
312
TREAT INSUFFICIENT RESOURCES
YES
309
FORWARD SERVICE REQUEST TO SERVICES CLIENT
315
SERVICES CLIENT PROCESSES SERVICE REQUEST
318
SERVICES CLIENT QUERIES BILLING SERVER
321
SUBSCRIPTION DATA INDICATES ACCESS DEVICE HAS PRE-PAYMENT CAPABILITY
324
SERVICES CLIENT INDICATES A DIALOGUE WITH FEATURE SERVER
327
SERVICES CLIENT INITIATES A SESSION ESTABLISHMENT DIALOGUE
330
TERMINATING ELEMENT ESTABLISHES AN ACCOUNTING SET
333
SERVICES CLIENT RECEIVES SESSION ACCEPT AND FORWARDS TO ACCESS DEVICE
336
FEATURE SERVER RECEIVES CURRENT SAMPLE AND EXECUTES COSTING ALGORITHM
339
IS CREDIT AVAILABLE?
NO
342
NOTIFY SERVICES CLIENT
YES
345
DISCONNECT AFTER SESSION COMPLETE
348
ISSUE END-OF-SESSION NOTIFICATIONS
351
ACCESS NETWORK RELEASES RESOURCES

FIG.3

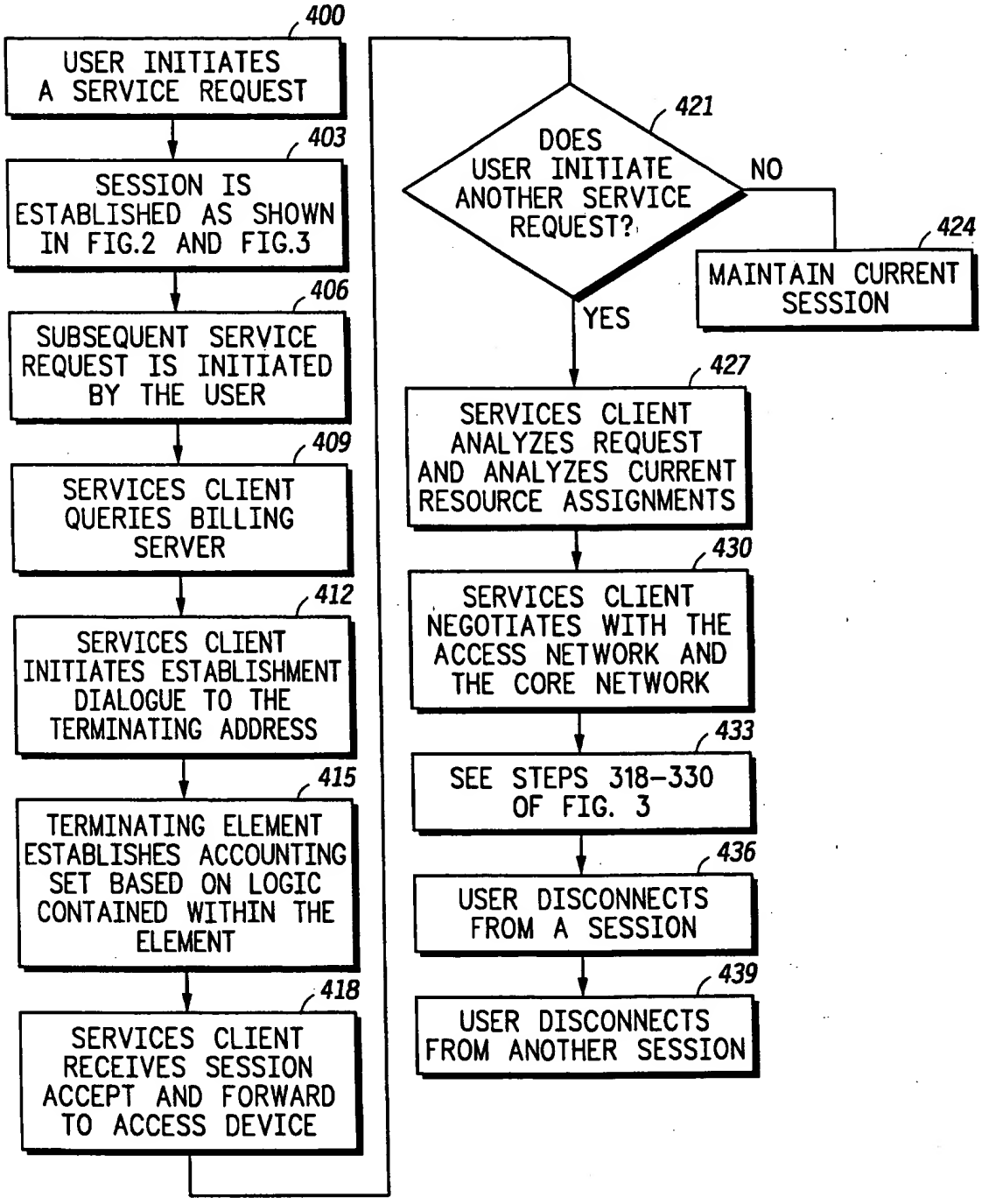
400
USER INITIATES A SERVICE REQUEST
403
SESSION IS ESTABLISHED AS SHOWN IN FIG.2 AND FIG.3
406
SUBSEQUENT SERVICE REQUEST IS INITIATED BY THE USER
409
SERVICES CLIENT QUERIES BILLING SERVER
412
SERVICES CLIENT INITIATES ESTABLISHMENT DIALOGUE TO THE TERMINATING ADDRESS
415
TERMINATING ELEMENT ESTABLISHES ACCOUNTING SET BASED ON LOGIC CONTAINED WITHIN THE ELEMENT
418
SERVICES CLIENT RECEIVES SESSION ACCEPT AND FORWARD TO ACCESS DEVICE
421
DOES USER INITIATE ANOTHER SERVICE REQUEST?
NO
424
MAINTAIN CURRENT SESSION
YES
427
SERVICES CLIENT ANALYZES REQUEST AND ANALYZES CURRENT RESOURCE ASSIGNMENTS
430
SERVICES CLIENT NEGOTIATES WITH THE ACCESS NETWORK AND THE CORE NETWORK
433
SEE STEPS 318–330 OF FIG. 3
436
USER DISCONNECTS FROM A SESSION
439
USER DISCONNECTS FROM ANOTHER SESSION

FIG.4

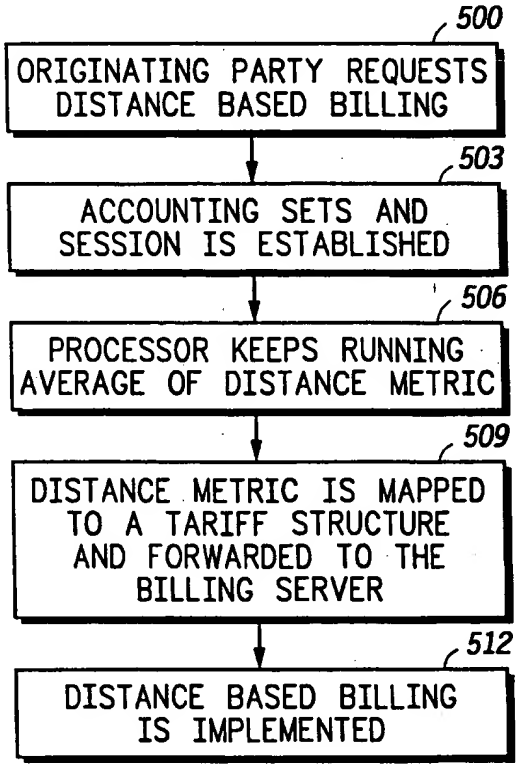
500
ORIGINATING PARTY REQUESTS DISTANCE BASED BILLING
503
ACCOUNTING SETS AND SESSION IS ESTABLISHED
506
PROCESSOR KEEPS RUNNING AVERAGE OF DISTANCE METRIC
509
DISTANCE METRIC IS MAPPED TO A TARIFF STRUCTURE AND FORWARDED TO THE BILLING SERVER
512
DISTANCE BASED BILLING IS IMPLEMENTED

FIG.5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/07012

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H04M 15/00; H04J 3/12
US CL : 379/114; 705/400; 709/227

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 379/114; 705/400; 709/227

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
USPAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US 5,920,613 A (ALCOTT et al.) 06 July 1999 (06.07.1999), abstract.	1-23
Y	US 5,537,464 A (LEWIS et al.) 16 July 1996 (15.07.1996), abstract, col.3-4.	1-23
Y	US 5,680,390 A (ROBROCK, II) 21 October 1997 (21.10.1997), col.8	1-23
Y	US 5,187,710 A (CHAU et al.) 16 February 1993 (16.02.1993), abstract, col.1-2	1-23

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
09 June 2000 (09.06.2000)	29 AUG 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer D. Dinh Telephone No. 305-9600 Regenia Logan

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